

Table A6. Incidence of neoplastic findings in male mice with glyphosate administered by diet. Part II. From Knezevich & Hogan, 1983 [18]. BN = Benign, MG = Malignant, MS = Metastatic.

Glyphosate (ppm)	0	Low (1000)	Mid (5000)	High (30 000)
SPLEEN				
MG Hemangio-endothelioma	0/48 (0%)	0/49 (0%)	1/50 (2%)	0/49 (0%)
MS Histiocytic sarcoma	0/48 (0%)	1/49 (2%)	0/50 (0%)	0/49 (0%)
MS Lymphoblastic lymphosarcoma	1/48 (2%)	2/49 (4%)	2/50 (4%)	0/49 (0%)
MG Lymphoblastic lymphosarcoma with leukaemic manifestations	0/48 (0%)	2/49 (4%)	0/50 (0%)	1/49 (2%)
PANCREAS				
MS Histiocytic Sarcoma	0/48 (0%)	1/48 (2%)	0/50 (0%)	0/49 (0%)
MS Lymphoblastic lymphosarcoma with leukaemic manifestations	0/48 (0%)	0/48 (0%)	1/49 (2%)	0/50 (0%)
KIDNEYS				
BN Renal tubule adenoma	0/49 (0%)	0/49 (0%)	1/50 (2%)	3/50 (6%)
MS Histiocytic sarcoma	0/49 (0%)	1/49 (2%)	0/50 (0%)	0/50 (0%)
MS Composite lymphosarcoma	1/49 (2%)	0/49 (0%)	0/50 (0%)	0/50 (0%)
MS Lymphoblastic lymphosarcoma with leukaemic manifestations	1/49 (2%)	3/49 (6%)	2/50 (4%)	2/50 (4%)
ADRENAL GLANDS				
BN Cortical adenoma	1/48 (2%)	2/49 (4%)	0/50 (0%)	1/48 (2%)
MS Lymphoblastic lymphosarcoma with leukaemic manifestations	0/48 (0%)	1/49 (2%)	0/50 (0%)	0/48 (0%)
BN Lymphoblastic lymphosarcoma with leukaemic manifestations	0/48 (0%)	0/49 (0%)	1/49 (2%)	0/48 (0%)
HARDERGIAN GLAND				
BN Adenoma	1/47 (2%)	0/48 (0%)	0/45 (0%)	0/48 (0%)
MG Liposarcoma	0/47 (0%)	0/48 (0%)	1/45 (2%)	0/48 (0%)
BONE MARROW				
MS Lymphoblastic lymphosarcoma with leukaemic manifestations	1/40 (2%)	2/45 (4%)	1/47 (2%)	1/49 (2%)
LYMPH NODE				
MS Histiocytic sarcoma	0/0 (0%)	1/3 (33%)	0/2 (0%)	0/2 (0%)
MS Composite lymphosarcoma	0/0 (0%)	0/3 (0%)	1/2 (50%)	0/2 (0%)
MS Lymphoblastic lymphosarcoma with leukaemic manifestations	0/0 (0%)	1/3 (33%)	1/2 (50%)	0/2 (0%)
MG Lymphoblastic lymphosarcoma with leukaemic manifestations	0/0 (0%)	0/3 (0%)	0/2 (0%)	1/2 (50%)
TESTES				
BN Interstitial cell tumor	1/49 (2%)	0/48 (0%)	2/50 (4%)	0/50 (0%)
MS Lymphoblastic lymphosarcoma with leukaemic manifestations	0/49 (0%)	1/48 (2%)	0/50 (0%)	0/50 (0%)
BN Lymphoblastic lymphosarcoma with leukaemic manifestations	0/49 (0%)	0/48 (0%)	1/50 (2%)	0/50 (0%)

Table A7. Incidence of neoplastic findings in female mice with glyphosate administered by diet. Part I. From Knezevich & Hogan, 1983 [18]. BN = Benign, MG = Malignant, MS = Metastatic.

Glyphosate (ppm)	Controls	Low	Mid	High
	0	Low (1000)	Mid (5000)	High (30 000)
BRAIN				
MS Lymphoblastic lymphosarcoma with leukaemic manifestations	0/50 (0%)	0/49 (0%)	1/50 (2%)	0/50 (0%)
HEART				
MS Lymphoblastic lymphosarcoma with leukaemic manifestations	0/50 (0%)	0/50 (0%)	2/50 (4%)	0/49 (0%)
LUNGS				
BN Bronchiolar-alveolar adenoma	10/49 (20%)	9/50 (18%)	10/49 (20%)	1/50 (2%)
MG Bronchiolar-alveolar adenocarcinoma	1/49 (2%)	3/50 (6%)	4/49 (8%)	4/50 (8%)
BN Granulosa cell tumour	0/49 (0%)	1/50 (2%)	0/49 (0%)	0/50 (0%)
MS Lymphoblastic lymphosarcoma with leukaemic manifestations	1/49 (2%)	2/50 (4%)	5/49 (10%)	1/50 (2%)
MS Lymphoblastic lymphosarcoma	0/50 (0%)	0/50 (0%)	0/49 (0%)	1/50 (2%)
LIVER				
MG Hepatocellular adenocarcinoma	1/49 (2%)	2/50 (4%)	1/49 (2%)	0/49 (0%)
BN Hepatocellular adenoma	0/49 (0%)	1/50 (2%)	0/49 (0%)	0/49 (0%)
MS Leiomyosarcoma	0/49 (0%)	1/50 (2%)	0/49 (0%)	0/49 (0%)
MS Granulocytic leukaemia	0/49 (0%)	3/50 (6%)	0/49 (0%)	0/49 (0%)
MG Hemangiendothelioma	0/49 (0%)	0/50 (0%)	2/49 (4%)	0/49 (0%)
MS Composite lymphosarcoma	2/49 (4%)	1/50 (2%)	0/49 (0%)	4/49 (8%)
MS Lymphoblastic lymphosarcoma with leukaemic manifestations	1/49 (2%)	4/50 (8%)	4/49 (8%)	1/49 (2%)
MS Lymphoblastic lymphosarcoma	0/49 (0%)	0/50 (0%)	0/49 (0%)	2/49 (4%)
MESENTERIC LYMPH NODES				
MS Leimyosarcoma	0/49 (0%)	1/49 (2%)	0/48 (0%)	0/48 (0%)
MS Granulocytic leukaemia	0/49 (0%)	1/49 (2%)	0/48 (0%)	0/48 (0%)
MG Lymphoblastic lymphosarcoma with leukaemic manifestations	0/49 (0%)	3/49 (6%)	1/48 (2%)	1/48 (2%)
MS Lymphoblastic lymphosarcoma with leukaemic manifestations	1/49 (2%)	1/49 (2%)	3/48 (6%)	0/48 (0%)
MS Composite lymphosarcoma	1/49 (2%)	1/49 (2%)	1/48 (2%)	3/48 (6%)
MG Lymphoblastic lymphosarcoma	0/49 (0%)	0/48 (0%)	0/48 (0%)	2/48 (4%)
MS Lymphoblastic lymphosarcoma	0/49 (0%)	0/49 (0%)	0/49 (0%)	1/49 (2%)
MS Haemangiendothelioma	0/49 (0%)	0/49 (0%)	0/49 (0%)	1/49 (2%)

Table A8. Incidence of neoplastic findings in female mice with glyphosate administered by diet. Part II. From Knezevich & Hogan, 1983 [18]. BN = Benign, MG = Malignant, MS = Metastatic.

Glyphosate (ppm)	Controls	Low	Mid	High
	0	Low (1000)	Mid (5000)	High (30 000)
MEDIASTINAL LYMPH NODES				
MS Leiomyosarcoma	0/42 (0%)	1/48 (2%)	0/39 (0%)	0/47 (0%)
MS Granulocytic leukaemia	0/42 (0%)	1/48 (2%)	0/39 (0%)	0/47 (0%)
MS Liposarcoma	1/42 (2%)	0/48 (0%)	0/39 (0%)	0/47 (0%)
MS Composite lymphosarcoma	1/42 (2%)	1/48 (2%)	0/39 (0%)	2/47 (4%)
MS Lymphoblastic lymphosarcoma with leukaemic manifestations	0/42 (0%)	1/48 (2%)	3/39 (8%)	0/47 (0%)
MG Lymphoblastic lymphosarcoma with leukaemic manifestations	1/42 (2%)	1/48 (2%)	2/39 (5%)	0/47 (0%)
MS Lymphoblastic lymphosarcoma	0/42 (0%)	1/48 (2%)	0/39 (0%)	1/47 (2%)
SALIVARY GLAND				
MS Leiomyosarcoma	0/50 (0%)	0/50 (0%)	1/50 (2%)	0/47 (0%)
SPLEEN				
MG Hemangio-endothelioma	1/50 (2%)	0/48 (0%)	2/49 (4%)	1/49 (2%)
MG Granulocytic leukemia	0/50 (0%)	3/48 (6%)	0/49 (0%)	0/49 (0%)
MS Hemangio-endothelioma	0/50 (0%)	0/48 (0%)	0/49 (0%)	1/49 (2%)
MS Lymphoblastic lymphosarcoma with leukaemic manifestations	1/50 (2%)	2/48 (4%)	2/49 (4%)	0/49 (0%)
MG Lymphoblastic lymphosarcoma with leukaemic manifestations	0/50 (0%)	0/48 (0%)	2/49 (4%)	0/49 (0%)
MG Composite lymphosarcoma	1/50 (2%)	1/48 (2%)	1/49 (2%)	5/49 10%
MS Lymphoblastic lymphosarcoma	0/50 (0%)	0/48 (0%)	0/49 (0%)	1/49 (2%)
STOMACH				
MG Leiomyosarcoma	0/48 (0%)	0/49 (0%)	1/50 (2%)	0/50 (0%)
MG Gastric adenocarcinoma	0/48 (0%)	0/49 (0%)	1/50 (2%)	0/50 (0%)
PANCREAS				
MS Granulocytic leukaemia	0/47 (0%)	1/47 (2%)	0/49 (0%)	0/50 (0%)
MS Composite lymphosarcoma	2/47 (4%)	1/47 (2%)	0/49 (0%)	1/50 (2%)
MS Lymphoblastic lymphosarcoma with leukaemic manifestations	1/47 (2%)	1/47 (2%)	1/49 (2%)	0/50 (0%)
KIDNEYS				
MS Leiomyosarcoma	0/50 (0%)	1/50 (2%)	0/50 (0%)	0/50 (0%)
MS Granulocytic leukaemia	0/50 (0%)	1/50 (2%)	0/50 (0%)	0/50 (0%)
MS Composite lymphosarcoma	2/50 (4%)	1/50 (2%)	1/50 (2%)	2/50 (4%)
MS Lymphoblastic lymphosarcoma with leukaemic manifestations	1/50 (2%)	2/50 (4%)	3/50 (6%)	1/50 (2%)
MS Lymphoblastic lymphosarcoma	0/50 (0%)	0/50 (0%)	0/50 (0%)	1/50 (2%)

Table A9. Incidence of neoplastic findings in female mice with glyphosate administered by diet. Part III. From Knezevich & Hogan, 1983 [18]. BN = Benign, MG = Malignant, MS = Metastatic.

Glyphosate (ppm)	Controls	Low	Mid	High
	0	Low (1000)	Mid (5000)	High (30 000)
URINARY BLADDER				
MS Granulocytic leukaemia	0/47 (0%)	1/43 (2%)	0/49 (0%)	0/48 (0%)
MS Composite lymphosarcoma	1/47 (2%)	1/43 (2%)	0/49 (0%)	0/48 (0%)
MS Lymphoblastic lymphosarcoma with leukaemic manifestations	1/47 (2%)	2/43 (4%)	2/49 (4%)	0/48 (0%)
OVARIES				
MG Teratoma	0/47 (0%)	1/47 (2%)	0/50 (0%)	0/47 (0%)
MG Granulosa cell tumour	0/47 (0%)	1/47 (2%)	0/50 (0%)	0/47 (0%)
MS Leiomyosarcoma	0/47 (0%)	1/47 (2%)	0/50 (0%)	0/47 (0%)
MS Lymphoblastic lymphosarcoma with leukaemic manifestations	0/47 (0%)	1/47 (2%)	0/50 (0%)	0/47 (0%)
MS/BN Lymphoblastic lymphosarcoma with leukaemic manifestations	1/47 (2%)	0/47 (0%)	2/50 (4%)	0/47 (0%)
UTERUS				
MS Leiomyoma	2/49 (4%)	1/48 (2%)	1/49 (2%)	1/50 (2%)
MG Leiomyosarcoma	2/49 (4%)	3/48 (6%)	2/49 (4%)	3/50 (6%)
MG Endometrial stromal cell carcinoma	0/49 (0%)	1/48 (2%)	0/49 (0%)	0/50 (0%)
MS Haemangioma	0/49 (0%)	1/48 (2%)	0/49 (0%)	0/50 (0%)
MG Haemangio-endothelioma	0/49 (0%)	0/48 (0%)	0/49 (0%)	1/50 (0%)
MS Lymphoblastic lymphosarcoma with leukaemic manifestations	0/49 (0%)	3/48 (6%)	1/49 (2%)	0/50 (0%)
CERVIX				
MG Leiomyosarcoma	0/0 (0%)	2/2 (100%)	0/0 (0%)	0/1 (0%)
THYROID				
MS Follicular adenoma	0/43 (0%)	0/37 (0%)	1/49 (2%)	0/48 (0%)
SKIN				
MG Fibrosarcoma	0/45 (0%)	1/45 (2%)	1/49 (2%)	0/48 (0%)
MAMMARY				
MG Ductal adenocarcinoma	2/38 (5%)	4/36 (11%)	2/40 (5%)	1/38 (3%)
MS Lymphoblastic lymphosarcoma with leukaemic manifestations	0/38 (0%)	0/36 (0%)	1/40 (3%)	0/38 (0%)
BONE MARROW				
MS Lymphoblastic lymphosarcoma with leukaemic manifestations	0/46 (0%)	1/49 (2%)	3/47 (6%)	1/49 (2%)
MS Lymphoblastic lymphosarcoma	0/46 (0%)	0/49 (0%)	0/47 (0%)	2/49 (4%)
MS Composite lymphosarcoma	0/46 (0%)	0/49 (0%)	0/47 (0%)	1/49 (2%)

ACKNOWLEDGMENTS

This work benefited from discussions with Yi-Wan Chen, Nancy Swanson, Bob Davidson, James Beecham and Gerry Koenig. This work was funded in part by Quanta Computers, Taipei, Taiwan, under the auspices of the Qmulus Project.

REFERENCES

- Swanson, N.L., Leu, A., Abrahamson, J. & Wallet, B. Genetically engineered crops, glyphosate and the deterioration of health in the United States of America. *J. Organic Systems* **9** (2014) 6–37.
- World Health Organization. IARC Monographs Volume 112: *Evaluation of Five Organophosphate Insecticides and Herbicides*. (20 March 2015).
- Guyton, K.Z., Loomis, D., Grosse, Y., El Ghissassi F., Benbrahim-Tallaa, L., Guha, N., Scoccianti, C., Mattock, H. & Straif, K., on behalf of the International Agency for Research on Cancer Monograph Working Group, IARC, Lyon, France. Carcinogenicity of tetrachlorvinphos, parathion, malathion, diazinon, and glyphosate. *The Lancet* **16** (2015) 490–491.
- Jayasumana, C., Gunatilake, S. & Senanayake, P. Glyphosate, hard water and nephrotoxic metals: Are they the culprits behind the epidemic of chronic kidney disease of unknown etiology in Sri Lanka? *Int. J. Environ. Res. Public Health* **11** (2014) 2125–2147.
- Jayasumana, C., Paranagama, P., Agampodi, S., Wijewardane, C., Gunatilake, S. & Siribaddana, S. Drinking well water and occupational exposure to Herbicides is associated with chronic kidney disease, in Padavi-Sripura, Sri Lanka. *Environ. Health* **14** (2015) 6.
- Stengel, B. Chronic kidney disease and cancer: a troubling connection. *J. Nephrol.* **23** (2010) 253–262.
- Séralini, G.E., Clair, E., Mesnage, R., Dufarge, N., Malatesta, M., Hennequin, D. & Spiroux de Vendômois, J. Republished study: Long-term toxicity of a Roundup herbicide and a Roundup-tolerant genetically modified maize. *Environ. Sci. Eur.* **26** (2014) 14.
- Miller, K. Estrogen and DNA damage: The silent source of breast cancer? *Natl Cancer Inst.* **95** (2003) 100–102.
- Thongprakaisang, S., Thiantanawat, A., Rangkadilok, N., Surio, T. & Satayavivad, J. Glyphosate induces human breast cancer cells growth via estrogen receptors. *Food Chem. Toxicol.* **39** (2013) 129–136.
- Vandenbergh, L.N., Colborn, T., Hayes, T.B., Heindel, J.J., Jacobs, D.R. Jr., Lee, D.-H., Shioda, T., Soto, A.M., vom Saal, F.S., Welshons, W.V., Zoeller, T.Z. & Myers, J.P. Hormones and endocrine-disrupting chemicals: Low-dose effects and nonmonotonic dose responses. *Endocr. Rev.* **33** (2012) 378–455.
- Samsel, A. & Seneff, S. Glyphosate's suppression of cytochrome P450 enzymes and amino acid biosynthesis by the gut microbiome: pathways to modern diseases. *Entropy* **15** (2013) 1416–1463.
- Balkwill, F., Charles, K.A. & Mantovani, A. Smoldering and polarized inflammation in the initiation and promotion of malignant disease. *Cancer Cell* **7** (2005) 211–217.
- Monsanto. A three-generation reproduction study in rats with glyphosate. Final Report. Bio/dynamics Project No. 77-2063. Submitted to EPA for evaluation. (31 March 1981).
- Monsanto. Addendum to pathology report for a three-generation reproduction study in rats with glyphosate. R.D. #374; Special Report MSL-1724. EPA Registration No 524-308, Action Code 401. Accession No 247793. CASWELL#661A. (6 July 1982).
- Stout, L.D. & Ruecker, F.A. Chronic study of glyphosate administered in feed to albino rats. Unpublished Study, Project No. MSL-10495. Monsanto Agricultural Company (2,175 pp.) EPAMRID416438-01 (26 September 1990).
- Hogan, G.K. & Knezovich, A.L. A chronic feeding study of glyphosate (Roundup technical) in mice. Unpublished Study No. BDN-77420, Project No 77-2061. Bio/dynamics Inc for Monsanto (3,419 pp.) Accession #251007-251014 MRID 130406 (1983).
- Lankas, G.R. and Hogan, G.K. A lifetime feeding study of glyphosate (Roundup technical) in rats Project #77-2062. (Unpublished study received 20 January 1982 under 524-308; Bio/dynamics Inc., submitted by Monsanto to the EPA. Includes the study's 4-volume Quality Control evaluation of the Bio/dynamics assessment performed by Experimental Pathology Laboratories, Inc. (2,914 pp.) CDL:246617-A; 246618; 246619; 246620; 246621). MRID 00093879.
- Knezovich, A.L. & Hogan, G.K. A chronic feeding study of glyphosate (Roundup technical) in mice. Project # 77-2061. (Unpublished study received 29 January 1982 under 524-308; prepared by Bio/dynamics, Inc., submitted by Monsanto to EPA Washington, DC., CDL:246617-A; 246618; 246619; 246620; 246621). MRID #00093879 (1983).
- Nakatsuji, S., Yamate, J. & Sakuma, S. Macrophages, myofibroblasts, and extracellular matrix accumulation in interstitial fibrosis of chronic progressive nephropathy in aged rats. *Vet. Pathol.* **35** (1998) 352–360.
- Shimizu, A., Masuda, Y., Ishizaki, M., Sugisaki, Y. & Yamanaka, N. Tubular dilatation in the repair process of ischaemic tubular necrosis. *Virchows Arch.* **425** (1994) 281–290.
- Meyer, T.W. Tubular injury in glomerular disease. *Kidney Int.* **63** (2003) 774–787.
- Niendorf, E.R., Parker, J.A., Yechoor, V., Garber, J.R. & Boiselle, P.M. Thymic hyperplasia in thyroid cancer patients. *J. Thoracic Imaging* **20** (2005) 1–4.
- Lee, D.K., Hakim, F.T. & Gress, R.E. The thymus and the immune system: Layered levels of control. *J. Thoracic Oncol.* **5** (10, Suppl 4) (2010) S273–S276.
- European Commission. Guidance document for GLP inspectors and GLP test facilities. Version 2, 2004–11–26 / MPA-RH.
- Ridley, W.P. & Mirly, K. The metabolism of glyphosate in Sprague Dawley rats. Part I. Excretion and tissue distribution of glyphosate and its metabolites following intravenous and oral administration. (Unpublished study MSL-7215 conducted by Monsanto's Environmental Health Laboratory and submitted to the EPA July 1988) MRID#407671-01. (1988).
- Howe, R.K., Chott, R.C. & McClanahan, R.H. The metabolism of glyphosate in Sprague Dawley rats. Part II. Identification, characterization and quantification of glyphosate and its metabolites after intravenous and oral administration. (Unpublished study MSL-7206 conducted by Monsanto and submitted to the EPA July 1988) MRID#407671-02. (1988).

27. Colvin, L.B., Moran, S.J. & Miller, J.A. Final report on CP 67573 residue and metabolism. Part 11. The metabolism of aminomethylphosphonic acid-14C(CP 50435- 14C) in laboratory rat. Monsanto Commercial Products Co. Agricultural Research Report No. 303 (1973); EPA Accession No. 93849.
28. Sutherland, M.L. Metabolism of N-nitrosophosphonomethylglycine in the laboratory rat. Monsanto Final Report No. MSL-0242 (1978); EPA Accession No. 233913.
29. Mesnage, R., Defarge, N., Rocque, L.-M., Spiroux de Vendômois, J. & Séralini, G.-E. Laboratory rodent diets contain toxic levels of environmental contaminants: Implications for regulatory tests. *PLoS ONE* **10** (2015) e0128429.
30. Dixon, D., Heider, K. & Elwell, M.R. Incidence of nonneoplastic lesions in historical control male and female Fischer-344 rats from 90-day toxicity studies. *Toxicol. Pathol.* **23** (1995) 338–348.
31. Korc, M. (1983) Manganese action on pancreatic protein synthesis in normal and diabetic rats. *Am. J. Physiol.* **245** Part 1 (1983) G628–34.
32. Dosselaere, F. & Vanderleyden, J. A metabolic node in action: Chorismate-utilizing enzymes in microorganisms. *Crit. Rev. Microbiol.* **27** (2001) 75–131.
33. Yi, K. Folate and DNA methylation: A mechanistic link between folate deficiency and colorectal cancer? *Cancer Epidemiol. Biomarkers Prevention* **13** (2004) 511–519.
34. Duthie, S.J. Folic acid deficiency and cancer: Mechanisms of DNA instability. *Br. Med. Bull.* **55** (1999) 578–592.
35. Scalpari, T.S., Bramati, V. & Erba, A. New uses of choline chloride in agrochemical formulations. European Patent Application Number 11305356.5 (10 March 2012).
36. Richman, E.L., Kenfield, S.A., Stampfer, M.J., Giovannucci, E.L., Zeisel, S.H., Willett, W.C. & Chan, J.M. Choline intake and risk of lethal prostate cancer: incidence and survival. *Am. J. Clin. Nutr.* **96** (2012) 855–863.
37. Marc, J., Mulner-Lorillon, O. & Bellé, R. Glyphosate-based pesticides affect cell cycle regulation. *Biol. Cell* **96** (2004) 245–249.
38. How, V., Hashim, Z., Ismail, P., Md Said, S., Omar, D. & Bahri Mohd Tamrin, S. Exploring cancer development in adulthood: cholinesterase depression and genotoxic effect from chronic exposure to organophosphate pesticides among rural farm children. *J. Agromed.* **19** (2014) 35–43.
39. Modesto, K.A. & Martinez, C.B.R. Roundup causes oxidative stress in liver and inhibits acetylcholinesterase in muscle and brain of the fish Prochilodus lineatus. *Chemosphere* **78** (2010) 294–299.
40. Bolognesi, C., Bonatti, S., Degan, P., Gallerani, E., Peluso, M., Rabboni, R., Roggieri, P. & Abbondandolo, A. Genotoxic activity of glyphosate and its technical formulation Roundup. *J. Agric. Food Chem.* **45** (1997) 1957–1962.
41. Braz-Mota, S., Sadauskas-Henrique, H., Duarte, R.M., Val, A.L. & Almeida-Val, V.M. Roundup exposure promotes gills and liver impairments, DNA damage and inhibition of brain cholinergic activity in the Amazon teleost fish *Colossoma macropomum*. *Chemosphere* **135** (2015) 53–60.
42. Cavas, T. & Köen, S. Detection of cytogenetic and DNA damage in peripheral erythrocytes of goldfish (*Carassius auratus*) exposed to a glyphosate formulation using the micronucleus test and the comet assay. *Mutagenesis* **22** (2007) 263–268.
43. Guilherme, S., Santos, M.A., Barroso, C., Gaivão, I. & Pacheco, M. Differential genotoxicity of Roundup formulation and its constituents in blood cells of fish (*Anguilla anguilla*): considerations on chemical interactions and DNA damaging mechanisms. *Eco-toxicology* **21** (2012) 1381–1390.
44. Guilherme, S., Gaivão, I., Santos, M.A. & Pacheco, M. European eel (*Anguilla anguilla*) genotoxic and pro-oxidant responses following short-term exposure to Roundup glyphosate-based herbicide. *Mutagenesis* **25** (2010) 523–530.
45. Ames, B.N. DNA damage from micronutrient deficiencies is likely to be a major cause of cancer. *Mutation Res.* **475** (2001) 7–20.
46. Rossi, M., Amaretti, A. & Raimondi, S. Folate production by probiotic bacteria. *Nutrients* **3** (2011) 118–134.
47. Shehata, A.A., Schrödl, W., Aldin, A.A., Hafez, H.M. & Krüger, M. The effect of glyphosate on potential pathogens and beneficial members of poultry microbiota in vitro. *Curr. Microbiol.* **66** (2013) 350–358.
48. Lu, W., Li, L., Chen, M., Zhou, Z., Zhang, W., Ping, S., Yan, Y., Wang, J. & Lin, M. Genome-wide transcriptional responses of *Escherichia coli* to glyphosate, a potent inhibitor of the shikimate pathway enzyme 5-enolpyruylshikimate-3-phosphate synthase. *Mol. Biosys.* **9** (2013) 522–530.
49. Benachour, N. & Séralini G.-E. Glyphosate formulations induce apoptosis and necrosis in human umbilical, embryonic, and placental cells. *Chem. Res. Toxicol.* **22** (2009) 97–105.
50. Richard, S., Moslemi, S., Sipahutar, H., Benachour, N. & Séralini, G.E. Differential effects of glyphosate and Roundup on human placental cells and aromatase. *Environ. Health Perspect.* **113** (2005) 716–720.
51. Benachour, N., Sipahutar, H., Moslemi, S., Gasnier, C., Travert, C., and Séralini, G.E. Time and dose-dependent effects of Roundup on human embryonic and placental cells and aromatase inhibition. *Arch. Environ. Contam. Toxicol.* **53** (2007) 126–133.
52. Ugarte, R. Interaction between glyphosate and mitochondrial succinate dehydrogenase. *Computational Theor. Chem.* **1043** (2014) 54–63.
53. Peixoto, F. Comparative effects of the Roundup and glyphosate on mitochondrial oxidative phosphorylation. *Chemosphere* **61** (2005) 1115–1122.
54. King, A., Selak, M.A. & Gottlieb, E. Succinate dehydrogenase and fumarate hydratase: Linking mitochondrial dysfunction and cancer. *Oncogene* **25** (2006) 4675–4682.
55. Woods, W.G., Gao, R.N., Shuster, J.J., Robison, L.L., Bernstein, M., Weitzman, S., Bunin, G., Levy, I., Brossard, J., Dougherty, G., Tuchman, M. & Lemieux, B. Screening of infants and mortality due to neuroblastoma. *N. Engl. J. Med.* **346** (2002) 1041–1046.
56. Rapizzi, E., Ercolino, T., Fucci, R., Zampetti, B., Felici, R., Guasti, D., Morandi, A., Giannoni, E., Giaché, V., Bani, D., Chiarugi, A. & Mannelli, M. Succinate dehydrogenase subunit B mutations modify human neuroblastoma cell metabolism and proliferation. *Hormones Cancer* **5** (2014) 174–184.
57. Warburg, O. On the origin of cancer cells. *Science* **123** (1956) 309–314.

58. Kim, J.W. & Dang, C.V. Cancer's molecular sweet tooth and the Warburg effect. *Cancer Res.* **66** (2006) 8927–8930.
59. Rippert, P., Scimemi, C., Dubald, M. & Matringe, M. Engineering plant shikimate pathway for production of tocotrienol and improving herbicide resistance. *Plant Physiol.* **134** (2004) 92–100.
60. Cleary C.M., Moreno, J.A., Fernández, B., Ortiz, A., Parra, E.G., Gracia, C., Blanco-Colio, L.M., Barat, A. & Egido, J. Glomerular haematuria, renal interstitial haemorrhage and acute kidney injury. *Nephrol. Dialysis Transplantation* **25** (2010) 4103–4106.
61. Nagababu, E., Chrest, F.J. & Rifkind, J.M. Hydrogen-peroxide-induced heme degradation in red blood cells: The protective roles of catalase and glutathione peroxidase. *Biochim Biophys Acta.* **1620** (2003) 211–217.
62. Ayala, A., Muñoz, M.F. & Argüelles, S. Lipid peroxidation: Production, metabolism, and signaling mechanisms of malondialdehyde and 4-hydroxy-2-nonenal. *Oxidative Med. Cellular Longevity* **2014** (2014) 360438.
63. Nielsen, F., Mikkelsen, B.B., Nielsen, J.B., Andersen, H.R. & Grandjean, P. Plasma malondialdehyde as biomarker for oxidative stress: reference interval and effects of lifestyle factors. *Clin. Chem.* **43** (1997) 1209–1214.
64. Beuret, C.J., Zirulnik, F. & Giménez, M.S. Effect of the herbicide glyphosate on liver lipoperoxidation in pregnant rats and their fetuses. *Reprod. Toxicol.* **19** (2005) 501–504.
65. Desai, K.M., Chang, T., Wang, H., Banigesh, A., Dhar, A., Liu, J., Untereiner, A. & Wu, L. Oxidative stress and aging: Is methylglyoxal the hidden enemy? *Can. J. Physiol. Pharmacol.* **88** (2010) 273–284.
66. Wang, Y. & Ho, C.T. Flavour chemistry of methylglyoxal and glyoxal. *Chem. Soc. Rev.* **41** (2012) 4140–4149.
67. Stopper, H., Schinzel, R., Sebekova, K. & Heidland, A. Genotoxicity of advanced glycation end products in mammalian cells. *Cancer Lett.* **190** (2003) 151–156.
68. Tan, D., Wang, Y., Lo, C.Y. & Ho, C.T. Methylglyoxal: Its presence and potential scavengers. *Asia Pacific J. Clin. Nutr.* **17** (Suppl 1) (2008) 261–264.
69. Alibhai, M.F. & Stallings, W.C. Closing down on glyphosate inhibition with a new structure for drug discovery. *Proc. Natl Acad. Sci. USA* **98** (2001) 2944–2946.
70. Grüning, N.M., Du, D., Keller, M.A., Luisi, B.F. & Ralser, M. Inhibition of triosephosphate isomerase by phosphoenolpyruvate in the feedback-regulation of glycolysis. *Open Biol.* **4** (2014) 130232.
71. Fraenkel, D.G. The phosphoenolpyruvate-initiated pathway of fructose metabolism in *Escherichia coli*. *J. Biol. Chem.* **243**(24) (1968) 6458–6463.
72. Richard, J.P. Mechanism for the formation of methylglyoxal from triosephosphates. *Biochem. Soc. Trans.* **21** (1993) 549–553.
73. Ahmed, N., Battah, S., Karachalias, N., Babaei-Jadidi, R., Horányi, M., Baróti, K., Hollan, S. & Thornalley, P.J. Increased formation of methylglyoxal and protein glycation, oxidation and nitrosation in triosephosphate isomerase deficiency. *Biochim. Biophys. Acta* **1639** (2003) 121–132.
74. Rabbani, N. & Thornalley, P.J. The critical role of methylglyoxal and glyoxalase 1 in diabetic nephropathy. *Diabetes* **63** (2014) 50–52.
75. Rendeiro, C., Masnik, A.M., Mun, J.G., Du, K., Clark, D., Dilger, R.N., Dilger, A.C. & Rhodes, J.S. Fructose decreases physical activity and increases body fat without affecting hippocampal neurogenesis and learning relative to an isocaloric glucose diet. *Sci. Rep.* **5** (2015) 9589.
76. Dhar, I., Dhar, A., Wu, L. & Desai, K.M. Increased methylglyoxal formation with upregulation of renin angiotensin system in fructose fed Sprague Dawley rats. *PLoS One* **8** (2013) e74212.
77. Papsoulis, A., Al-Abed, Y. & Bucala, R. Identification of N²-(1-carboxyethyl)guanine (CEG) as a guanine advanced glycosylation end product. *Biochemistry* **34** (1995) 648–655.
78. Xu, X.C., Brinker, R.J., Reynolds, T.L., Abraham, W. & Graham, J.A. Pesticide compositions containing oxalic acid. US patent number 6,992,045 (2006).
79. Buc, H.A., Demaugre, F., Moncion, A. & Leroux, J.P. Metabolic consequences of pyruvate kinase inhibition by oxalate in intact rat hepatocytes. *Biochimie* **63** (1981) 595–602.
80. Okombo, J. & Liebman, M. Probiotic-induced reduction of gastrointestinal oxalate absorption in healthy subjects. *Urol. Res.* **38** (2010) 169–178.
81. Svedruzic, D., Jónsson, S., Toyota, C.G., Reinhardt, L.A., Ricagno, S., Lindqvist, Y. & Richards, N.G.J. The enzymes of oxalate metabolism: unexpected structures and mechanisms. *Arch. Biochem. Biophys.* **433** (2005) 176–192.
82. Samsel, A. & Seneff, S. Glyphosate, pathways to modern diseases III: Manganese, neurological diseases, and associated pathologies. *Surg. Neurol. Int.* **6** (2015) 45.
83. Krüger, M., Schrödl, W., Neuhaus, J. & Shehata, A.A. Field investigations of glyphosate in urine of Danish dairy cows. *J. Environ. Anal. Toxicol.* **3** (2013) 17.
84. Nikiforova, V.J., Giesbertz, P., Wiemer, J., Bethan, B., Looser, R., Liebenberg, V., Noppinger, P.R., Daniel, H. & Rein D. Glyoxylate, a new marker metabolite of type 2 diabetes. *J. Diabetes Res.* **2014** (2014) 685204.
85. Duncan, R.J. & Tipton, K.F. The oxidation and reduction of glyoxylate by lactic dehydrogenase. *Eur. J. Biochem.* **11** (1969) 58–61.
86. Novoa, W.B., Winer, A.D., Glaid, A.J. & Schwert, G.W. Lactic dehydrogenase: V. Inhibition by oxamate and by oxalate. *J. Biol. Chem.* **234** (1959) 1143–1148.
87. Moser, H. Process for producing N-phosphonomethylglycine. US patent number 4,534,904. (1984).
88. Rogers, TE & Smith, LR. Process for the preparation of glyphosate and glyphosate derivatives. European Patent Application #85870195.6. (1985).
89. Pollegioni, L., Schonbrunn, E. & Siehl, D. Molecular basis of glyphosate resistance—different approaches through protein engineering. *FEBS J.* **278** (2011) 2753–2766.
90. Shangari, N., Chan, T.S., Popovic, M. & O'Brien, P.J. Glyoxal markedly compromises hepatocytes resistance to hydrogen peroxide. *Biochem. Pharmacol.* **71** (2006) 1610–1618.
91. Shangari, N. & O'Brien, P.J. The cytotoxic mechanism of glyoxal involves oxidative stress. *Biochem. Pharmacol.* **68** (2004) 1433–1442.
92. Johnson, D.E. 21-day dermal toxicity study in rabbits. (Unpublished study 401-168, March 10, 1982 By IRDC, Mattawan, MI) submitted by Monsanto to EPA Washington, DC., MRID#00098460.

93. Kalapos, M.P. Methylglyoxal in living organisms: Chemistry, biochemistry, toxicology and biological implications. *Toxicol. Lett.* **110** (1999) 145–175.
94. de Liz Oliveira Cavalli, V.L., Cattani, D., Heinz Rieg, C.E., Pierozan, P., Zanatta, L., Benedetti Parisotto, E., Wilhelm Filho, D., Mena Barreto Silva, F.R., Pessoa-Pureur, R. & Zamoner, A. Roundup disrupts male reproductive functions by triggering calciummediated cell death in rat testis and Sertoli cells. *Free Radical Biol. Med.* **65** (2013) 335–346.
95. Murata-Kamiya, N. & Kamiya, H. Methylglyoxal, an endogenous aldehyde, crosslinks DNA polymerase and the substrate DNA. *Nucl. Acids Res.* **29** (2001) 3433–3438.
96. Nagao, M., Fujita, Y., Sugimura, T. & Kosuge, T. Methylglyoxal in beverages and foods: Its mutagenicity and carcinogenicity. *IARC Scientific Publications* **70** (1986) 283–291.
97. Nafziger, E.D., Widholm, J.M., Steinrcken, H.C. & Killmer, J.L. Selection and characterization of a carrot cell line tolerant to glyphosate. *Plant Physiol.* **76** (1984) 571–574.
98. Ferla, M.P. & Patrick, W.M. Bacterial methionine biosynthesis. *Microbiology* **160** (2014) 1571–1584.
99. Brouwers, O., Niessen, P.M., Ferreira, I., Miyata, T., Scheffer, P.G., Teerlink, T., Schrauwel, P., Brownlee, M., Stehouwer, C.D. & Schalkwijk, C.G. Overexpression of glyoxalase-I reduces hyperglycemia-induced levels of advanced glycation end products and oxidative stress in diabetic rats. *J. Biol. Chem.* **286** (2011) 1374–1380.
100. Jain, M., Choudhary, D., Kale, R.K. & Bhalla-Sarin, N. Salt- and glyphosate-induced increase in glyoxalase I activity in cell lines of groundnut (*Arachis hypogaea*). *Physiologia Plantarum* **114** (2002) 499–505.
101. Cheng, W.-L., Tsai, M.-M., Tsai, C.-Y., Huang, Y.-H., Chen, C.-Y., Chi, H.-C., Tseng, Y.-H., Chao, I.-W., Lin, W.-C., Wu, S.-M., Liang, Y., Liao, C.-J., Lin, Y.-H., Chung, I.-H., Chen, W.-J., Lin, P.Y., Wang, C.-S. & Lin, K.-H. Glyoxalase-I is a novel prognosis factor associated with gastric cancer progression. *PLoS ONE* **7** (2012) e34352.
102. Baunacke, M., Horn, L.C., Trettner, S., Engel, K.M., Hemdan, N.Y., Wiechmann, V., Stolzenburg, J.U., Bigl, M. & Birkenmeier, G. Exploring glyoxalase 1 expression in prostate cancer tissues: targeting the enzyme by ethyl pyruvate defangs some malignancyassociated properties. *Prostate* **74** (2014) 48–60.
103. Jemal, A., Siegel, R., Ward, E., Hao, Y., Xu, J., Murray, T. & Thun, M.J. Cancer statistics. *CA Cancer J. Clin.* **58** (2008) 71–96.
104. Wu, G.S. Role of mitogen-activated protein kinase phosphatases (MKPs) in cancer. *Cancer Metastasis Rev.* **26** (2007) 579–85.
105. Pickering Laboratories, Inc. Analysis of N-Nitroso Glyphosate in Glyphosate Samples. LCGC (Feb 1, 2010). <http://www.chromatographyonline.com/analysis-n-nitrosoglyphosate-glyphosate-samples>. (Last accessed 12 June 2015).
106. Loh, Y.H., Jakszyn, P., Luben, R.N., Mulligan, A.A., Mitrou, P.N. & Khaw, K.-T. N-nitroso compounds and cancer incidence: the European Prospective Investigation into Cancer and Nutrition (EPIC) Norfolk Study. *Am. J. Clin. Nutr.* **93** (2011) 1053–1061.
107. Bogovski, P. & Bogovski, S. Animal species in which N-nitroso compounds induce cancer. *Int. J. Cancer* **27** (1981) 471–474.
108. Schmähl, D. & Habs, M. Carcinogenicity of N-nitroso compounds. *Oncology* **37** (1980) 237–242.
109. Montesano, R. & Magee, P.N. Metabolism of dimethylnitrosamine by human liver slices in vitro. *Nature (Lond.)* **228** (1970) 173–174.
110. Wogan, G.N. & Tannenbaum, S.R. Environmental N-nitroso compounds: Implications for public health. *Toxicol. Appl. Pharmacol.* **31** (1975) 375–383.
111. Lijinsky, W. Intestinal cancer induced by N-nitroso compounds. *Toxicol. Pathol.* **16** (1988) 198–204.
112. Zhu, Y., Wang, P.P., Zhao, J., Green, R., Sun, Z., Roebothan, B., Squires, J., Buehler, S., Dicks, E., Zhao, J., Cotterchio, M., Campbell, P.T., Jain, M., Parfrey, P.S., McLaughlin, J.R. Dietary N-nitroso compounds and risk of colorectal cancer: a case-control study in Newfoundland and Labrador and Ontario. *Br. J. Nutr.* **111** (2014) 1109–1117.
113. FAO Specifications and Evaluations for Plant Protection Products: Glyphosate, N-(phosphonomethyl)glycine, (evaluation report 284) (2001).
114. Monsanto Agricultural Products Company, Standard Analytical Method No. AQC-684-86 (1986).
115. Kim, M., Stripeikis, J., Inón, F. & Tudino, M. A simplified approach to the determination of N-nitroso glyphosate in technical glyphosate using HPLC with post-derivatization and colorimetric detection. *Talanta* **72** (2007) 1054–1058.
116. Liu, C.-M., McLean, P.A., Sookdeo, C.C. & Cannon, F.C. Degradation of the herbicide glyphosate by members of the family Rhizobiaceae. *Appl. Environ. Microbiol.* **57** (1991) 1799–1804.
117. Wogan, G.N., Paglialunga, S., Archer, M.C. & Tannenbaum, S.R. Carcinogenicity of nitrosation products of ephedrine, sarcosine, folic acid, and creatinine. *Cancer Res.* **35** (1975) 1981–1984.
118. Sreekumar, A., Poisson, L.M., Rajendiran, T.M., Khan, A.P., Cao, Q., Yu, J., Laxman, B., Mehra, R., Lonigro, R.J., Li, Y., et al. Metabolomic profiles delineate potential role for sarcosine in prostate cancer progression. *Nature* **457** (2009) 910–914.
119. Khan, A.P., Rajendiran, T.M., Ateeq, B., Asangani, I.A., Athanikar, J.N., Yocum, A.K., Mehra, R., Siddiqui, J., Palapattu, G., Wei, J.T., Michailidis, G., Sreekumar, A. & Chinnaian, A.M. The role of sarcosine metabolism in prostate cancer progression. *Neoplasia* **15** (2013) 491–501.
120. Jemal, A., Bray, F., Center, M.M., Ferlay, J., Ward, E. & Forman, D. Global cancer statistics. *CA Cancer J. Clin.* **61** (2011) 69–90.
121. Li, Q., Lambrechts, M.J., Zhang, Q., Liu, S., Ge, D., Yin, R., Xi, M. & You, Z. Glyphosate and AMPA inhibit cancer cell growth through inhibiting intracellular glycine synthesis. *Drug Design Development Therapy* **7** (2013) 635–43.
122. Rose, M.L., Cattley, R.C., Dunn, C., Wong, V., Li, X. & Thurman, R.G. Dietary glycine prevents the development of liver tumors caused by the peroxisome proliferator WY-14,643. *Carcinogenesis* **20** (1999) 2075–81.
123. Yamashina, S., Ikejima, K., Rusyn, I., Sato, N. Glycine as a potent anti-angiogenic nutrient for tumor growth. *J. Gastroenterol. Hepatol.* **22** (Suppl. 1) (2007) S62–64.
124. Lees, H.J., Swann, J.R., Wilson, I.D., Nicholson, J.K. & Holmes, E. Hippurate: the natural history of a mammalian-microbial cometabolite. *J. Proteome Res.* **12** (2013) 1527–1546.

125. Gregus, Z., Fekete, T., Varga, F. & Klaassen, C.D. Dependence of glycine conjugation on availability of glycine: role of the glycine cleavage system. *Xenobiotica* **23** (1993) 141–153.
126. Waldram, A., Holmes, E., Wang, Y., Rantalainen, M., Wilson, I.D., Tuohy, K.M., McCartney, A.L., Gibson, G.R. & Nicholson, J.K. Top-down systems biology modeling of host metabotype-microbiome associations in obese rodents. *J. Proteome Res.* **8** (2009) 2361–2375.
127. Calvani, R., Miccheli, A., Capuani, G., Tomassini Miccheli, A., Puccetti, C., Delfini, M., Iaconelli, A., Nanni, G. & Mingrone, G. Gut microbiome-derived metabolites characterize a peculiar obese urinary metabotype. *Int. J. Obesity* **34** (2010) 1095–1098.
128. Williams, H.R.T., Cox, I.J., Walker, D.G., North, B.V., Patel, V.M., Marshall, S.E., Jewell, D.P., Ghosh, S., Thomas, H.J.W., Teare, J.P., Jakobovits, S., Zeki, S., Welsh, K.I., Taylor-Robinson, S.D. & Orchard, T.R. Characterization of inflammatory bowel disease with urinary metabolic profiling. *Am. J. Gastroenterol.* **104** (2009) 1435–1444.
129. Hemminki, K., Li, X., Sundquist, J. & Sundquist, K. Cancer risks in Crohn disease patients. *Ann. Oncol.* **20**(3) (2009) 574–580.
130. Lim, J.S., Mietus-Snyder, M., Valente, A., Schwarz, J.-M. & Lustig, R.H. The role of fructose in the pathogenesis of NAFLD and the metabolic syndrome. *Nature Rev. Gastroenterol. Hepatol.* **7** (2010) 251–264.
131. Michelotti, G.A., Machado, M.V. & Diehl, A.M. NAFLD, NASH and liver cancer. *Nature Rev. Gastroenterol. Hepatol.* **10** (2013) 656–665.
132. Ascha, M.S., Hanouneh, I.A., Lopez, R., Tamimi, T.A., Feldstein, A.F. & Zein, N.N. The incidence and risk factors of hepatocellular carcinoma in patients with nonalcoholic steatohepatitis. *Hepatology* **51** (2010) 1972–1978.
133. Fernández-Zamorano, A., Arnalich, F., Codoceo, R., Vigara, M.R., Valverde, F., Jara, P. & Vázquez, J.J. Hemolytic anemia and susceptibility to hydrogen-peroxide hemolysis in children with vitamin E-deficiency and chronic liver disease. *J. Med.* **19** (1988) 317–334.
134. Masuda, Y., Ichii, H., Vaziri, N.D. At pharmacologically relevant concentrations intravenous iron preparations cause pancreatic beta cell death. *Am. J. Transl. Res.* **6** (2014) 64–70.
135. Villeneuve, J.P. & Pichette, V. Cytochrome P450 and liver diseases. *Curr. Drug Metab.* **5** (2004) 273–282.
136. Hotamisligil, G.S. Inflammation and metabolic disorders. *Nature* **444** (2006) 860–867.
137. Tsuei, J., Chau, T., Mills, D. & Wan, Y.-J.Y. Bile acid dysregulation, gut dysbiosis, and gastrointestinal cancer. *Exp. Biol. Med.* **239** (2014) 1489–1504.
138. Shanab, A.A., Scully, P., Crosbie, O., Buckley, M., O'Mahony, L., Shanahan, F., Gazareen, S., Murphy, E. & Quigley, E.M. Small intestinal bacterial overgrowth in nonalcoholic steatohepatitis: association with toll-like receptor 4 expression and plasma levels of interleukin 8. *Digestive Dis. Sci.* **56** (2011) 1524–1534.
139. Ilan, Y. Leaky gut and the liver: a role for bacterial translocation in nonalcoholic steatohepatitis. *World J. Gastroenterol.* **18** (2012) 2609–2618.
140. Kappas, A., Sassa, S., Galbraith, R.A. & Nordmann, Y. The porphyrias. In: Scriver, C.R., Beaudet, A.L., Sly, W.S. & Valle, D., eds. *The Metabolic and Molecular Bases of Inherited Disease*. 7th ed. Vol. 2. New York: McGraw-Hill, 2103–59. (1995).
141. Kauppinen, R. & Mustajoki, P. Acute hepatic porphyria and hepatocellular carcinoma. *Br. J. Cancer* **57** (1988) 117–20.
142. Andersson, C., Bjersing, L. & Lithner, F. The epidemiology of hepatocellular carcinoma in patients with acute intermittent porphyria. *J. Intern. Med.* **240** (1996) 195–201.
143. Hardell, L., Bengtsson, N.O., Jonsson, U., Eriksson, S. & Larsson, L.G. Aetiological aspects on primary liver cancer with special regard to alcohol, organic solvents and acute intermittent porphyria { an epidemiological investigation. *Br. J. Cancer* **50** (1984) 389–397.
144. Kitchen, L.M., Witt, W.W. & Rieck, C.E. Inhibition of -aminolevulinic acid synthesis by glyphosate. *Weed Sci.* **29** (1981) 571–577.
145. Kitchen, L.M., Witt, W.W. & Rieck, C.E. Inhibition of chlorophyll accumulation by glyphosate. *Weed Science* **29**(4) (1981) 513–516.
146. Lee, D.H., Blomhoff, R. & Jacobs, D.R. Jr. Is serum gamma glutamyltransferase a marker of oxidative stress? *Free Radical Res.* **38** (2004) 535–539.
147. Fentiman, I.S. Gamma-glutamyl transferase: risk and prognosis of cancer. *Br. J. Cancer* **106** (2012) 1467–1468.
148. Whitfield, J.B. Serum -glutamyltransferase and risk of disease. *Clin. Chem.* **53** (2007) 1–2.
149. Kazemi-Shirazi, L., Endler, G., Winkler, S., Schickbauer, T., Wagner, O. & Marsik, C. Gamma glutamyltransferase and long-term survival: Is it just the liver? *Clin. Chem.* **53** (2007) 940–946.
150. Mok, Y., Son, D.K., Yun, Y.D., Jee, S.H. & Samet, J.M. Glutamyltransferase and cancer risk: the Korean Cancer Prevention Study. *Int. J. Cancer* (2015) [Epub ahead of print].
151. Paolicchi, A., Tongiani, R., Tonarelli, P., Comporti, M. & Pompella, A. gamma-Glutamyl transpeptidase-dependent lipid peroxidation in isolated hepatocytes and HepG2 hepatoma cells. *Free Radical Biol. Med.* **22** (1997) 853–860.
152. Drozdz, R., Parmentier, C., Hachad, H., Leroy, P., Siest, G. & Wellman, M. gamma-Glutamyltransferase dependent generation of reactive oxygen species from a glutathione/transferrin system. *Free Radical Biol. Med.* **25** (1998) 786–792.
153. Mastellone, V., Tudisco, R., Monastra, G., Pero, M.E., Calabro, S., Lombardi, P., Grossi, M., Cutrignelli, M.I., Avallone, L. & Infascelli, F. Gamma-glutamyl transferase activity in kids born from goats fed genetically modified soybean. *Food Nutr. Sci.* **4** (2013) 50–54.
154. Bohn, T., Cuhra, M., Traavik, T., Sanden, M., Fagan, J. & Primicerio, R. Compositional differences in soybeans on the market: Glyphosate accumulates in Roundup Ready GM soybeans. *Food Chem.* **153** (2014) 207–215.
155. Benedetti, A.L., Vituri Cde, L., Trentin, A.G., Domingues, M.A. & Alvarez-Silva, M. The effects of sub-chronic exposure of Wistar rats to the herbicide Glyphosate-Biocarb. *Toxicol. Lett.* **153** (2004) 227–232.
156. Ala-Kokko, L., Pihlajaniemi, T., Myers, J.C., Kivirikko, K.I. & Savolainen, E.R. Gene expression of type I, III and IV collagens in hepatic fibrosis induced by dimethylnitrosamine in the rat. *Biochem. J.* **244** (1987) 75–79.

157. Hietanen, E., Linnainmaa, K. & Vainio, H. Effects of phenoxyherbicides and glyphosate on the hepatic and intestinal biotransformation activities in the rat. *Acta Pharmacol. Toxicol.* **53** (1983) 103–112.
158. Samsel, A. & Seneff, S. Glyphosate, pathways to modern diseases II: celiac sprue and gluten intolerance. *Interdiscip. Toxicol.* **6** (2013) 159–184.
159. Qian, L., Zolfaghari, R. & Ross, A.C. Liver-specific cytochrome P450 CYP2C22 is a direct target of retinoic acid and a retinoic acid-metabolizing enzyme in rat liver. *J. Lipid Res.* **51** (2010) 1781–1792.
160. Helms, J., Thaller, C. & Eichele, G. Relationship between retinoic acid and sonic hedgehog, two polarizing signals in the chick wing bud. *Development* **120** (1994) 3267–3274.
161. Philips, G.M., Chan, I.S., Swiderska, M., Schroder, V.T., Guy, C., Karaca, G.F., Moylan, C., Venkatraman, T., Feuerlein, S., Syn, W.-K., Jung, Y., Witek, R.P., Choi, S., Michelotti, G.A., Rangwala, F., Merkle, E., Lascola, C. & Diehl, A.M. Hedgehog signaling antagonist promotes regression of both liver fibrosis and hepatocellular carcinoma in a murine model of primary liver cancer. *PLoS ONE* **6** (2011) e23943.
162. Paganelli, A., Gnazzo, V., Acosta, H., López, S.L. & Carrasco, A.E. Glyphosate-based herbicides produce teratogenic effects on vertebrates by impairing retinoic acid signaling. *Chem. Res. Toxicol.* **23** (2010) 1586–1595.
163. Jemal, A., Thomas, A., Murray, T. & Thun, M. Cancer statistics, 2002. *CA Cancer J. Clin.* **52** (2002) 23–47.
164. Dhar, A., Dhar, I., Jiang, B., Desai, K.M. & Wu, L. Chronic methylglyoxal injection by minipump causes pancreatic beta-cell dysfunction and induces type 2 diabetes in Sprague Dawley rats. *Diabetes* **60** (2011) 899–908.
165. Baly, D.L., Curry, D.L., Keen, C.L. & Hurley, L.S. Effect of manganese deficiency on insulin secretion and carbohydrate homeostasis in rats. *J. Nutr.* **114** (1984) 1438–1446.
166. Klimstra, D.S., Heffess, C.S., Oertel, J.E. & Rosai, J. Acinar cell carcinoma of the pancreas: A clinicopathologic study of 28 cases. *Am. J. Surg. Pathol.* **16** (1992) 815–837.
167. Malatesta, M., Caporali, C., Rossi, L., Battistelli, S., Rocchi, M.B.L., Tonucci, F. & Gazzanelli, G. Ultrastructural analysis of pancreatic acinar cells from mice fed on genetically modified soybean. *J. Anat.* **201** (2002) 409–415.
168. Brooks, S.E. & Golden, M.H. The exocrine pancreas in kwashiorkor and marasmus. Light and electron microscopy. *West Indian Med. J.* **41** (1992) 56–60.
169. Kau, A.L., Planer, J.D., Liu, J., Rao, S., Yatsunenko, T., Trehan, I., Manary, M.J., Liu, T.-C., Stappenbeck, T.S., Maleta, K.M., Ashorn, P., Dewey, K.G., Houpt, E.R., Hsieh, C.-S. & Gordon, J.I. Functional characterization of IgA-targeted bacterial taxa from undernourished Malawian children that produce diet-dependent enteropathy. *Sci. Transl. Med.* **7** (276) (2015) 276ra24.
170. United States Environmental Protection Agency. Glyphosate-EPA Registration No. 524-308 - 2-Year Chronic Feeding/Oncogenicity Study in Rats with Technical Glyphosate. (13 December 1991). sustainablepulse.com/2015/03/26/who-glyphosate-report-ends-thirtyyear-cancer-cover-up/#.VSVPZ2Z3bJk (Last accessed 10 June 2015).
171. US Renal Data Systems. USRDS 2006 Annual Data Report: *Atlas of End-Stage Renal Disease in the United States*. Bethesda, Maryland: National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases (2007).
172. Coresh, J., Selvin, E., Stevens, L.A., Manzi, J., Kusek, J.W., Eggers, P., Van Lente F. & Levey, A.S. Prevalence of chronic kidney disease in the United States. *JAMA* **298** (2007) 2038–2047.
173. Tian, N., Arany, I., Waxman, D.J. & Baliga, R. Cytochrome P450 2B1 gene silencing attenuates puromycin aminonucleoside-induced cytotoxicity to glomerular epithelial cells. *Kidney Int.* **78** (2010) 182–190.
174. Chen, X., Mori, T., Guo, Q., Hu, C., Ohsaki, Y., Yoneki, Y., Zhu, W., Jiang, Y., Endo, S., Nakayama, K., Ogawa, S., Nakayama, M., Miyata, T. & Ito, S. Carbonyl stress induces hypertension and cardio-renal vascular injury in Dahl salt-sensitive rats. *Hypertens. Res.* **36** (2013) 361–367.
175. Sule, N., Yakupoglu, U., Shen, S.S., Krishnan, B., Yang, G., Lerner, S., Sheikh-Hamad, D. & Truong, L.D. Calcium oxalate deposition in renal cell carcinoma associated with acquired cystic kidney disease: A comprehensive study. *Am. J. Surg. Pathol.* **29** (2005) 443–451.
176. Rioux-Leclercq, N.C. & Epstein, J.I. Renal cell carcinoma with intratumoral calcium oxalate crystal deposition in patients with acquired cystic disease of the kidney. *Arch. Pathol. Lab. Med.* **127** (2003) E89–E92.
177. Torres, V.E., Bengal, R.J., Litwiller, R.D. & Wilson, D.M. Aggravation of polycystic kidney disease in Han:SPRD rats by buthionine sulfoximine. *J. Am. Soc. Nephrol.* **8** (1997) 1283–1291.
178. Chiang, C.C., Lin, C.L., Peng, C.L., Sung, F.C. & Tsai, Y.Y. Increased risk of cancer in patients with early-onset cataracts: a nationwide population-based study. *Cancer Sci.* **105** (2014) 431–436.
179. Palsamy, P., Bidasee, K.R., Ayaki, M., Augusteyn, R.C., Chan, J.Y. & Shinohara, T. Methylglyoxal induces endoplasmic reticulum stress and DNA demethylation in the Keap1 promoter of human lens epithelial cells and age-related cataracts. *Free Radical Biol. Med.* **72** (2014) 134–148.
180. Shamsi, F.A., Lin, K., Sady, C. & Nagaraj, R.H. Methylglyoxal-derived modifications in lens aging and cataract formation. *Invest. Ophthalmol. Vis. Sci.* **39** (1998) 2355–2364.
181. Okonkwo, F.O., Ejike, C.E.C.C., Anoka, A.N. & Onwurah, I.N.E. Toxicological studies on the short term exposure of Clarias albopunctatus (Lamonte and Nichole 1927) to sub-lethal concentrations of Roundup. *Pakistan J. Biol. Sci.* **16** (2013) 939–944.
182. Floreani, A., Baragiotta, A., Martines, D., Naccarato, R. & D'odorico, A. Plasma antioxidant levels in chronic cholestatic liver diseases. *Aliment. Pharmacol. Ther.* **14** (2000) 353–358.
183. Ribaya-Mercado, J.D. & Blumberg J.B. Lutein and zeaxanthin and their potential roles in disease prevention. *J. Am. Coll. Nutr.* **23** (6, Suppl) (2004) 567S–587S.
184. Gao, S., Qin, T., Liu, Z., Caceres, M.A., Ronchi, C.F., Chen, C.Y., Yeum, K.J., Taylor, A., Blumberg, J.B., Liu, Y. & Shang, F. Lutein and zeaxanthin supplementation reduces H2O2-induced oxidative damage in human lens epithelial cells. *Mol. Vision* **17** (2011) 3180–3190.
185. Ohrloff, C., Stoffel, C., Koch, H.R., Wefers, U., Bouris, J. & Hockwin, O. Experimental cataracts in rats due to tryptophan-free diet. *Arch. Klin. Exp. Ophthalmol.* **205** (1978) 73–79.

186. Zarnowski, T., Rejdak, R., Zielinska-Rzecka, E., Zrenner, E., Grieb, P., Zagórska, Z., Junemann, A. & Turki, W.A. Elevated concentrations of kynurenic acid, a tryptophan derivative, in dense nuclear cataracts. *Curr. Eye Res.* **32** (2007) 27–32.
187. De Roos, A.J., Blair, A., Rusiecki, J.A., Hoppin, J.A., Svec, M., Dosemeci, M., Sandler, D.P. & Alavanja, M.C. Cancer incidence among glyphosate-exposed pesticide applicators in the agricultural health study. *Environ. Health Perspectives* **113** (2005) 49–54.
188. George, J. & Shukla, Y. Emptying of intracellular calcium pool and oxidative stress imbalance are associated with the glyphosate-induced proliferation in human skin keratinocytes HaCaT cells. *ISRN Dermatol.* **2013** (2013) Article ID:825180.
189. Brenner, M. & Hearing, V.J. The protective role of melanin against UV damage in human skin. *Photochem. Photobiol.* **84** (2008) 539–549.
190. Raposo, G. & Marks, M.S. Melanosomes—dark organelles enlighten endosomal membrane transport. *Nature Rev. Mol. Cell. Biol.* **8** (2007) 786–797.
191. Slominski, A., Moellmann, G., Kuklinska, E., Bomirska, A. & Pawelek, J. Positive regulation of melanin pigmentation by two key substrates of the melanogenic pathway, L-tyrosine and L-dopa. *J. Cell Sci.* **89** (1988) 287–296.
192. Becerra, T.A., von Ehrenstein, O.S., Heck, J.E., Olsen, J., Arah, O.A., Jeste, S.S., Rodriguez, M. & Ritz, B. Autism spectrum disorders and race, ethnicity, and nativity: a population-based study. *Pediatrics* **134** (2014) e63–e71.
193. Magnusson, C., Rai, D., Goodman, A., Lundberg, M., Idring, S., Svensson, A., Koupil, I., Serlachius, E. & Dalman, C. Migration and autism spectrum disorder: population-based study. *Br. J. Psychiatry* **201** (2012) 109–115.
194. Keen, D.V., Reid, F.D. & Arnone, D. Autism, ethnicity and maternal immigration. *Br. J. Psychiatry* **196**(4) (2010) 274–281.
195. Hamilton, P.J., Campbell, N.G., Sharma, S., Erreger, K., Herborg Hansen, F., Saunders, C., Belovich, A.N., NIH ARRA Autism Sequencing Consortium, Sahai, M.A., Cook, E.H., Gether, U., McHaourab, H.S., Matthies, H.J., Sutcliffe, J.S. & Galli, A. De novo mutation in the dopamine transporter gene associates dopamine dysfunction with autism spectrum disorder. *Mol. Psychiatry* **18** (2013) 1315–1323.
196. Emanuele, E. Does reverse transport of dopamine play a role in autism? *EBioMedicine* **2** (2015) 98–99.
197. Nakamura, K., Anitha, A., Yamada, K., Tsujii, M., Iwayama, Y., Hattori, E., Toyota, T., Suda, S., Takei, N., Iwata, Y., Suzuki, K., Matsuzaki, H., Kawai, M., Sekine, Y., Tsuchiya, K.J., Sugihara, G., Ouchi, Y., Sugiyama, T., Yoshikawa, T. & Mori, N. Genetic and expression analyses reveal elevated expression of syntaxin 1A (STX1A) in high functioning autism. *Int. J. Neuropsychopharmacol.* **11** (2008) 1073–1084.
198. Qian, Y., Chen, M., Forssberg, H., Diaz & Heijtz R. Genetic variation in dopaminerelated gene expression influences motor skill learning in mice. *Genes Brain Behav.* **12** (2013) 604–614.
199. Munn, D.H., Shafizadeh, E., Attwood, J.T., Bondarev, I., Pashine, A., Mellor, A.L. Inhibition of T cell proliferation by macrophage tryptophan catabolism. *J. Exp. Med.* **189** (1999) 1363–1372.
200. Hwu, P., Du, M.X., Lapointe, R., Do, M., Taylor, M.W. & Young, H.A. Indoleamine 2,3-dioxygenase production by human dendritic cells results in the inhibition of T cell proliferation. *J. Immunol.* **164** (2000) 3596–3599.
201. Astigiano, S., Morandi, B., Costa, R., Mastracci, L., D'Agostino, A., Ratto, G.B., Melioli, G. & Frumento, G. Eosinophil granulocytes account for indoleamine 2,3-dioxygenase-mediated immune escape in human non-small cell lung cancer. *Neoplasia* **7** (2005) 390–396.
202. Amberger, A. Prognostic value of indoleamine 2,3-dioxygenase expression in colorectal cancer: effect on tumor-infiltrating T cells. *Clin. Cancer Res.* **12** (2006) 1144–1151.
203. Ishio, T., Goto, S., Tahara, K., Tone, S., Kawano, K. & Kitano, S. Immunoactivative role of indoleamine 2,3-dioxygenase in human hepatocellular carcinoma. *J. Gastroenterol. Hepatol.* **19** (2004) 319–326.
204. Basu, G.D., Tinder, T.L., Bradley, J.M., Tu, T., Hattrup, C.L., Pockaj, B.A. & Mukherjee, P. Cyclooxygenase-2 inhibitor enhances the efficacy of a breast cancer vaccine: role of IDO. *J. Immunol.* **177** (2006) 2391–2402.
205. Chen, P.W., Mellon, J.K., Mayhew, E., Wang, S., He, Y.G., Hogan, N. & Niederkorn, J.Y. Uveal melanoma expression of indoleamine 2,3-deoxygenase: Establishment of an immune privileged environment by tryptophan depletion. *Exp. Eye Res.* **85** (2007) 617–625.
206. Weinlich, G., Murr, C., Richardsen, L., Winkler, C. & Fuchs, D. Decreased serum tryptophan concentration predicts poor prognosis in malignant melanoma patients. *Dermatology* **214** (2007) 8–14.
207. Serbecic, N. & Beutelspacher, S.C. Indoleamine 2,3-dioxygenase protects corneal endothelial cells from UV mediated damage. *Exp. Eye Res.* **82** (2006) 416–426.
208. Takikawa, O., Littlejohn, T., Jamie, J.F., Walker, M.J. & Truscott, R.J. Regulation of indoleamine 2,3-dioxygenase, the first enzyme in UV filter biosynthesis in the human lens. Relevance for senile nuclear cataract. *Adv. Exp. Med. Biol.* **467** (1999) 241–245.
209. Bald, T., Quast, T., Landsberg, J., Rogava, M., Glodde, N., Lopez-Ramos, D., Kohlmeyer, J., Riesenbergs, S., van den Boorn-Konijnenberg, D., Höming-Hölzel, C., Reuten, R., Schadow, B., Weighardt, H., Wenzel, D., Helfrich, I., Schadendorf, D., Bloch, W., Bianchi, M.E., Lugassy, C., Barnhill, R.L., Koch, M., Fleischmann, B.K., Förster, I., Kastenmüller, W., Kolanus, W., Hölzel, M., Gaffal, E. & Tütting, T. Ultravioletradiation-induced inflammation promotes angiogenesis and metastasis in melano. *Nature* **507** (2014) 109–113.
210. Duntas, L.H. The role of selenium in thyroid autoimmunity and cancer. *Thyroid* **16** (2006) 455–60.
211. Whitehead, K., Versalovic, J., Roos, S. & Britton, R.A. Genomic and genetic characterization of the bile stress response of probiotic *Lactobacillus reuteri* ATCC 55730. *Appl. Environ. Microbiol.* **74** (2008) 1812–1819.
212. Lin, Y.P., Thibodeaux, C.H., Pena, J.A., Ferry, G.D. & Versalovic, J. Probiotic *Lactobacillus reuteri* suppress proinflammatory cytokines via c-Jun. *Inflamm. Bowel Dis.* **14** (2008) 1068–1083.
213. Galano, E., Mangiapane, E., Bianga, J., Palmese, A., Pessione, E., Szpunar, J., Lobinski, R. & Amoresano, A. Privileged incorporation of selenium as selenocysteine in *Lactobacillus reuteri* proteins demonstrated by selenium-

- specific imaging and proteomics. *Mol. Cell Proteomics* **12** (2013) 2196–2204.
214. Archibald, F.S. & Duong, M.N. Manganese acquisition by *Lactobacillus plantarum*. *J. Bacteriol.* **158** (1984) 1–8.
 215. Archibald, F.S. & Fridovich, I. Manganese, superoxide dismutase, and oxygen tolerance in some lactic acid bacteria. *J. Bacteriol.* **146** (1981) 928–936.
 216. Chlebowksi, R.T., Hendrix, S.L., Langer, R.D., Stefanick, M.L., Gass, M., Lane, D., Rodabough, R.J., Gilligan, M.A., Cyr, M.G., Thomson, C.A., Khandekar, J., Petrovitch, H., McTiernan, A. & WHI Investigators. Influence of estrogen plus progestin on breast cancer and mammography in healthy postmenopausal women: the Women's Health Initiative Randomized Trial. *JAMA* **289** (2003) 3243–3253.
 217. Hou, N., Hong, S., Wang, W., Olopade, O.I., Dignam, J.J. & Huo, D. Hormone replacement therapy and breast cancer: Heterogeneous risks by race, weight, and breast density. *J. Natl Cancer Inst.* **105** (2013) 1365–1372.
 218. Kochukov, Y., Jeng, J. & Watson, S. Alkylphenol xenoestrogens with varying carbon chain lengths differentially and potently activate signaling and functional responses in GH3/B6/F10 somatomammotropes. *Environ. Health Perspectives* **117** (2009) 723–730.
 219. Laden, F., Ishibe, N., Hankinson, S.E., Wolff, M.S., Gertig, D.M., Hunter, D.J. & Kelsey, K.T. Polychlorinated biphenyls, cytochrome P450 1A1, and breast cancer risk in the Nurses Health Study. *Cancer Epidemiol. Biomarkers Prevention* **11** (2002) 1560–1565.
 220. Meldahl, A.C., Nithipatikom, K. & Lech, J.J. Metabolism of several 14C-nonylphenol isomers by rainbow trout (*Oncorhynchus mykiss*): In vivo and in vitro microsomal metabolites. *Xenobiotica* **26** (1996) 1167–1180.
 221. Niwa, T., Fujimoto, M., Kishimoto, K., Yabusaki, Y., Ishibashi, F. & Katagiri, M. Metabolism and interaction of bisphenol A in human hepatic cytochrome P450 and steroidogenic CYP17. *Biol. Pharm. Bull.* **24**(9) (2001) 1064–1067.
 222. Liehr, J.G. & Jones, J. Role of iron in estrogen-induced cancer. *Current Med. Chem.* **8** (2001) 839–849.
 223. Kwiatkowska, M., Huras, B. & Bukowska, B. The effect of metabolites and impurities of glyphosate on human erythrocytes (in vitro). *Pestic. Biochem. Physiol.* **109** (2014) 34–43.
 224. Nagababu, E. & Rifkind, J.M. Heme degradation by reactive oxygen species. *Antioxidants Redox Signaling* **6** (2004) 967–978.
 225. Aberkane, H., Stoltz, J.-F.; Galteau, M.-M. & Wellman, M. Erythrocytes as targets for gamma-glutamyltranspeptidase initiated pro-oxidant reaction. *Eur. J. Haematol.* **68** (2002) 262–271.
 226. Adamson, P., Bray, F., Costantini, A.S., Tao, M.H., Weiderpass, E. & Roman, E. Time trends in the registration of Hodgkin and non-Hodgkin lymphomas in Europe. *Eur. J. Cancer* **43** (2007) 391–401.
 227. Eltom, M.A., Jemal, A., Mbulaiteye, S.M., Devesa, S.S. & Biggar, R.J. Trends in Kaposi's sarcoma and non-Hodgkin's lymphoma incidence in the United States from 1973 through 1998. *J. Natl. Cancer Inst.* **94** (2002) 1204–1210.
 228. Schinasi, L. & Leon, M.E. Non-Hodgkin lymphoma and occupational exposure to agricultural pesticide chemical groups and active ingredients: a systematic review and meta-analysis. *Int. J. Environ. Res. Public Health* **11** (2014) 4449–4527.
 229. Hardell, L., Eriksson, M. & Nordstrom, M. Exposure to pesticides as risk factor for non-Hodgkin's Lymphoma and hairy cell leukemia: pooled analysis of two Swedish casecontrol studies. *Leuk. Lymphoma* **43** (2002) 1043–1049.
 230. Eriksson, M., Hardell, L., Carlberg, M. & Akerman, M. Pesticide exposure as risk factor for non-Hodgkin lymphoma including histopathological subgroup analysis. *Int. J. Cancer* **123** (2008) 1657–1663.
 231. McDuffie, H.H., Pahwa, P., McLaughlin, J.R., Spinelli, J.J., Fincham, S., Dosman, J.A., Robson, D., Skinnider, L.F. & Choi, N.W. Non-Hodgkin's lymphoma and specific pesticide exposures in men: Cross-Canada study of pesticides and health. *Cancer Epidemiol. Biomarkers Prevention* **10** (2001) 1155–1163.
 232. Pervaiz, S. & Clement, M.V. Superoxide anion: Oncogenic reactive oxygen species? *Int. J. Biochem. Cell Biol.* **39** (2007) 1297–1304.
 233. Candas, D. & Li, J.J. MnSOD in oxidative stress response—potential regulation via mitochondrial protein inux. *Antioxid. Redox. Signal.* **20** (2014) 1599–1617.
 234. Van Remmen, H., Ikeno, Y., Hamilton, M., Pahlavani, M., Wolf, N., Thorpe, S.R., Alderson, N.L., Baynes, J.W., Epstein, C.J., Huang, T.-T., Nelson, J., Strong, R. & Richardson, A. Life-long reduction in MnSOD activity results in increased DNA damage and higher incidence of cancer but does not accelerate aging. *Physiol. Genomics* **16** (2003) 29–37.
 235. Jaramillo, M.C., Briehl, M.M., Crapo, J.D., Batinic-Haberle, I. & Tome, M.E. Manganese porphyrin, MnTE-2-PyP5+, acts as a pro-oxidant to potentiate glucocorticoid-induced apoptosis in lymphoma cells. *Free Radical Biol. Med.* **52** (2012) 1272–1284.
 236. Wang, Y.H., Yang, X.L., Han, X., Zhang, L.F. & Li, H.L. Mimic of manganese superoxide dismutase to induce apoptosis of human non-Hodgkin lymphoma Raji cells through mitochondrial pathways. *Int. Immunopharmacol.* **14** (2012) 620–628.
 237. Jaramillo, M.C., Frye, J.B., Crapo, J.D., Briehl, M.M. & Tome, M.E. Increased manganese superoxide dismutase expression or treatment with manganese porphyrin potentiates dexamethasone-induced apoptosis in lymphoma cells. *Cancer Res.* **69** (2009) 5450–5457.
 238. Crapo, J., Day, B. & Fridovich, I. Development of manganic porphyrin mimetics of superoxide dismutase activity. Madame Curie Bioscience Database. Landes Bioscience. Retrieved 10 June 2015.
 239. Cuzzocrea, S., Zingarelli, B., Costantino, G. & Caputi, A. Beneficial effects of Mn(II)tetrakis (4-benzoic acid) porphyrin (MnTBAP), a superoxide dismutase mimetic, in carrageenan-induced pleurisy. *Free Radical Biol. Med.* **26** (1999) 25–33.
 240. Conlan, M.G., Bast, M., Armitage, J.O. & Weisenburger, D.D. Bone marrow involvement by non-Hodgkin's lymphoma: the clinical significance of morphologic discordance between the lymph node and bone marrow. Nebraska Lymphoma Study Group. *J. Clin. Oncol.* **8** (1990) 1163–1172.
 241. Ridley, W.P. A study of the plasma and bone marrow levels of glyphosate following intraperitoneal administration in the rat. Unpublished report, study No. 830109, project No. ML-83-218, dated 24 October 1988, from Monsanto

- Environmental Health Laboratory, St. Louis, Missouri, USA. Submitted to WHO by Monsanto Int. Services SA, Brussels, Belgium (1983).
242. Prasad, S., Srivastava, S., Singh, M. & Shukla, Y. Clastogenic effects of glyphosate in bone marrow cells of Swiss albino mice. *J. Toxicol.* **2009** (2009) article ID:308985.
243. Raab, M.S., Podar, K., Breitkreutz, I., Richardson, P.G. & Anderson, K.C. Multiple myeloma. *Lancet* **374** (2009) 324–339.
244. Kapur, G., Patwari, A.K., Narayan, S. & Anand, V.K. Serum prolactin in celiac disease. *J. Trop. Pediatr.* **50** (2004) 37–40.
245. Goloubkova, T., Ribeiro, M.F., Rodrigues, L.P., Cecconello, A.L. & Spritzer, P.M. Effects of xenoestrogen bisphenol A on uterine and pituitary weight, serum prolactin levels and immunoreactive prolactin cells in ovariectomized Wistar rats. *Arch. Toxicol.* **74** (2000) 92–98.
246. Gudelsky, G.A., Nansel, D.D. & Porter, J.C. Role of estrogen in the dopaminergic control of prolactin secretion. *Endocrinology* **108** (1981) 440–444.